Analysis of the Level of Metacognitive Awareness and Students' Character Education Values of Eleventh-Grade Science in the Chemistry Learning Process

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Abstract. Chemistry learning is characterized by the study at the submicroscopic level, which includes structure, dynamics, and particle transformation, such as atoms, ions, and molecules. In addition, chemical concepts tend to be related to one another, making it difficult for students to understand. Metacognitive awareness supported by character education values is expected to be a solution so that students can learn chemistry well. The learning values inherent to students will support the application of metacognitive awareness to build effective and efficient learning conditions comprehensively. The technique used for sampling was proportional random sampling to five classes of eleventh-grade science students. The samples obtained were 24 students in each class, with a total of 120 students. The study found that (1) the metacognitive awareness of eleventh-grade science students of SMA Negeri 1 Sumbawa was dominant in the high category of 34.83%, (2) the character education values (curiosity, honesty, hard work, and discipline) were dominant in the high category of 41.76%. The students' metacognitive awareness and character education values should be maintained and developed sustainably. Consequently, the metacognitive character of students will remain consistent and cultured.

Keywords: Chemistry · Metacognitive awareness · Character education value

1 Introduction

Chemistry subjects require metacognitive aspects in the learning process. Chemistry subject is considered boring subjects because many materials memorize formulas and materials that need to be visualized during understanding [1]. As a result, students' reactions to chemistry lessons become less active, and it affects the results of student learning completeness. A proposed strategy to simplify chemistry lessons for students is a metacognitive strategy because it is easy to remember and understand through metacognitive information. Research conducted by Marsita and co-workers also showed that most high school students need more stimulation in learning chemistry [2]. Thus,

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so it can be concluded that students who lack interest in studying chemistry cannot study chemistry. They do not have curiosity, honesty, discipline, and hard work in doing chemistry learning.

Metacognitive abilities have a much-needed urgency in the learning process. Chemistry students, especially eleventh-grade science students at SMA Negeri 1 Sumbawa Besar, still need to fully attain metacognitive awareness. Interviews with the students of class XI MIA SMA Negeri 1 Sumbawa Besar revealed that chemistry subject is difficult subject to understand and teachers do not use special strategies for themselves in the chemistry learning process. According to the students, chemistry subject is difficult to understand because it contains abstract topics and requires the student to memorizing formulas, thereby reducing their interest in learning chemistry. Parallel to this opinion, respective teacher argued that students' interest tends to decrease when studying chemistry, and online learning conditions make students feel bored. According to research conducted by Chrissanti et al., if students are interested in learning, they tend to respond positively, such as by showing initiative, and willingness to learn more, including adding metacognitive awareness in the learning process [3]. In addition, from the interviews, students also lacked honesty, discipline, hard work, and curiosity in learning chemistry. The application of metacognitive awareness requires good character in students. Further, Rosita states that children who excel in character will be able to face all problems and challenges in their lives [4]. He will also be a lifelong learner. Therefore, the present study analyses the metacognitive awareness of students which is needed to support the attainment of learning indicators.

2 Materials and Methods

2.1 Research Type

This study uses a quantitative approach as it uses numerical data or numbers. The data were obtained through the metacognitive awareness inventory method and the values of character education. The quantitative approach in this study aims to determine the level of metacognitive awareness and the level of character education values possessed by students.

2.2 Research Design

The research design is descriptive and quantitative. Descriptive quantitative is a type of research that is used to analyze data by describing as it is [5]. Descriptive quantitative selection in this study was based on research that wanted to examine and see the level of aspects of metacognitive awareness and the level of character education values possessed by students. In this study, the supporting data used were the results of interviews with students and teachers of SMA Negeri 1 Sumbawa Besar.

2.2.1 Research Variable

Two variables being studied were variables related to the level of metacognitive awareness and variables related to the values of character education possessed by students.

Table 1. Distribution of population and research sample

Class	Total Students	Total Samples
XI MIA 1	33	24
XI MIA 2	34	24
XI MIA 3	35	24
XI MIA 4	35	24
XI MIA 5	35	24
$\sum$	172	120

2.2.2 Population and Sample

In this study, the population was eleventh-grade students of SMA Negeri 1 Sumbawa Besar Indonesia majoring in science with a total of 172 people. While the research sample was determined by the Slovin formula:

$$n = \frac{N}{1 + N(e)^2} \tag{1}$$

where:

n = sample size/number of respondents

N = population size

e = presentation of leniency accuracy sampling error that is still tolerable.

The provisions of the Slovin formula are as follows:

The value of e = 0.1 (10%) for a large population

The value of e = 0.2 (20%) for the population is a small amount [6].

Based on the results of calculations, by taking the value of e = 20%, the samples in this study were obtained as in Table 1.

2.2.3 Research Stages

At this research stage, there are three main stages carried out, namely the preparation stage, implementation stage, and data analysis.

a. Preparation phase

Sample determination. Of 172 students, 120 students were chosen as sample. After that, a metacognitive awareness questionnaire instrument and a questionnaire instrument for character education values were prepared. Then, finally, the validation of the questionnaire was carried out by a team of expert validators of the study program consisting of lecturers of the chemistry education study program.

b. Implementation Stage

Data collection on metacognitive awareness and the values of student character education is carried out through google form. A metacognitive awareness questionnaire was given first, followed by a questionnaire on the character education values of the students.

Table 2. Aiken's index

No.	Index Range	Category
1	$V \leq 0.4$	Not Valid
2	$0.4 < V \leq 0.8$	Valid
3	$0.8 < V \leq 1$	Very Valid

Source: [7]

c. Analysis Stage

First of all, an analysis of the research data was carried out, namely the metacognitive awareness questionnaire of the students. Furthermore, the data from the research results were analyzed, and the second variable, namely the questionnaire on the character education values of the students.

2.3 Research Instrument

2.3.1 Validity Test

The validity test is done by using an expert validity test. The data from the expert validation for each questionnaire were analyzed by considering the input, comments, rants, and suggestions from the validators. The results of the analysis are presented as a guideline for revising the questionnaire. To find out this agreement, Aiken's formulation for validity was used. The item validity index proposed by Aiken is formulated as follows:

$$V = \frac{\sum S}{n(C-1)} \tag{2}$$

(Retnawati, 2016) [7]

where:

V = index of rater agreement regarding item validity.

s = score assigned by each rater minus the lowest score in the category used (s = r-Io, where r = score High rater choice and lowest Io score scoring).

n = number of raters

c = number of categories selected by the rater.

From the results of the calculation of index V, an item or device can be categorized based on its index (Table 2).

Through an assessment using the Aiken index, the results of the validation of the metacognitive awareness questionnaire and the values of character education for all aspects can be known in Table 3 and Table 4.

2.3.2 Reliability Test

The analysis used to determine the level of reliability by two validators (on the same two aspects) on the questionnaire instrument sheet, using the following formula:

$$Percentage\ of\ agreement = \left[-\frac{A-B}{A+B}\right] \times 100\% \tag{3}$$

Table 3. Results of the validation analysis of the metacognitive awareness questionnaire instrument by the validator

No.	Item	Score	
		∑s	V
1.	Instructions for using the questionnaire are clearly stated	6	1.00
2.	Communicative sentence formulation	4	0.67
3.	Use of clear and easy-to-understand sentences	5	0.83
4.	Conformity between indicators and questionnaire statement items	6	1.00
5.	The statement used can measure aspects of students' self-assessment in measuring the level of metacognitive awareness.	5	0.83
Average		5.2	0.87

Table 4. The results of the validation analysis of the character education values questionnaire instrument by the validator

No.	Item	Score	
		∑s	V
1.	Instructions for using the questionnaire are clearly stated	6	1.00
2.	Communicative sentence formulation	4	0.67
3.	Use of clear and easy-to-understand sentences	5	0.83
4.	Conformity between indicators and questionnaire statement items	6	1.00
5.	The statement used can measure aspects of students' self-assessment in measuring the level of metacognitive awareness.	5	0.83
Average		5.2	0.87

(Trianto, 2011), [8].

where:

A = the result of the observer's assessment give higher value

B = the result of the observer's assessment that give lower value

The instrument is said to be good if it has an index of understanding of 0.75 or 75% [8]. The reliability of the metacognitive awareness questionnaire and the character education values questionnaire were determined using the percentage of agreement equation. The determination of the R-value is carried out for each component, as shown in Table 5 and Table 6.

Table 5. Metacognitive awareness questionnaire reliability results

No	Questionnaire Assessment Components	Questionnaire Component Average		
		A	B	R
1.	Instructions for using the questionnaire are clearly stated	4	4	1.00
2.	Communicative sentence formulation	3	3	1.00
3.	Use of clear and easy-to-understand sentences	4	3	0.86
4.	Conformity between indicators and questionnaire statement items	4	4	1.00
5.	The statement used can measure aspects of students' self-assessment in measuring the level of metacognitive awareness.	4	3	0.86
Average		3.80	3.40	0.94

Table 6. The results of the questionnaire of character education values

No	Questionnaire Assessment Components	Questionnaire Component Average		
		A	B	R
1.	Instructions for using the questionnaire are clearly stated	4	4	1.00
2.	Communicative sentence formulation	3	3	1.00
3.	Use of clear and easy-to-understand sentences	4	3	0.86
4.	Conformity between indicators and questionnaire statement items	4	4	1.00
5.	The statement used can measure aspects of students' self-assessment in measuring the level of metacognitive awareness.	4	3	0.86
Average		3.80	3.40	0.94

Based on the above table, the reliability research using the percentage of agreement on each component are 1; 1; 0.86; 1; 0.86, with an average percentage of agreement value of 0.94. So, it can be concluded that the metacognitive awareness questionnaire and the modified character education values are reliable or trustworthy because they have an R-value > 0.75.

3 Results and Discussion

3.1 Metacognitive Awareness Profile

The metacognitive awareness of students towards chemistry subjects can be seen in Fig. 1.

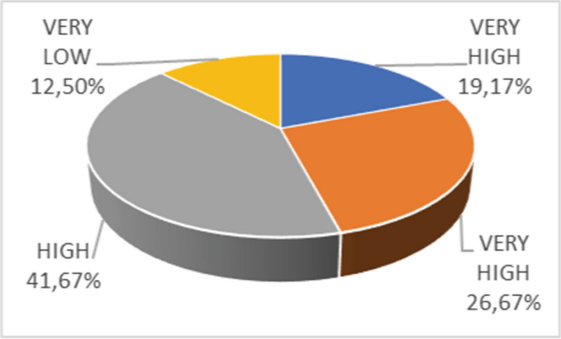

Fig. 1. Overall Data on Metacognitive Awareness of students

Based on Fig. 1, it can be concluded that the category of metacognitive awareness of students towards chemistry lessons is more in the high category of 35.83% with a total of 43 students from 120 samples. This high category means that students are aware of their thinking and can distinguish the input stages of elaboration and output of their thoughts. Sometimes students use this model to organize their thinking and learning. However, the metacognitive awareness of students with the low category is still quite large at 32.50% or with a total of 39 students from 120 samples. The category of low metacognitive awareness indicates that students' metacognitive awareness is still in the developing stage, so it can be improved to be even better if it is helped towards self-thinking awareness if stimulated or supported. In comparison, the category of very high and very low metacognitive awareness has the same number, namely 15.83% or with a total of 19 people from 120 samples. The diversity of levels of metacognitive awareness possessed by a person is influenced by his very diverse experiences and affects his ability to solve problems and his learning strategies [9]. In addition, other factors that can influence the diversity of students' metacognitive awareness are the extracurricular activities that are followed, facilities and infrastructure that support the learning process, interaction with the community in the surrounding environment, daily activities that become habits and other factors that affect the student's learning experience.

The number of each category of metacognitive awareness of students is distributed into five classes with a variety of students in each category. The metacognitive awareness of each class is explained based on Fig. 2.

The level of metacognitive awareness in each class is different. Based on the bar graph of the metacognitive awareness class data, it can be concluded that in class XI MIA 1, the more metacognitive awareness category is in a low category with a percentage of 33.33%. Furthermore, in class XI MIA 2 also, the level of metacognitive awareness of students is more in the low category of 37.50%. Likewise, with class XI MIA 3, the level of metacognitive awareness of students is mostly in the low category of 45.83%. While in class XI MIA 4 and class XI MIA 5, the metacognitive awareness category is mostly in the high category with percentages of 50% and 41.67%, respectively. The diversity of levels of metacognitive awareness that occurs in each class is due to several factors, one of which is the grouping of class XI MIA conducted by the school. The grouping is

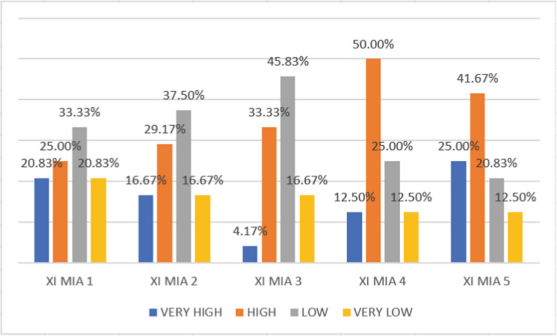

Fig. 2. Percentage of Metacognitive Awareness of students

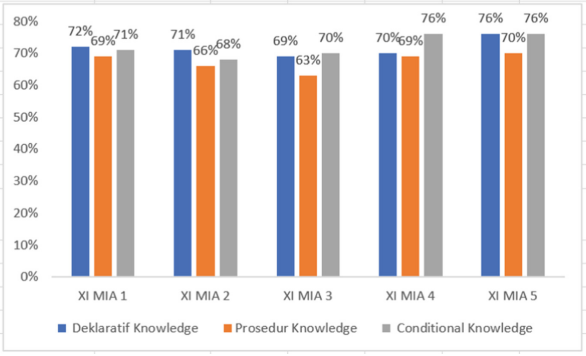

Fig. 3. Indicators of Metacognitive Knowledge for Individual MIA Class

based on the academic ability of the student. Therefore, based on these groupings, we get class XI MIA 4 and class XI MIA 5 as the superior class.

A description of the metacognitive awareness of each class is depicted in Fig. 3.

Based on the distribution graph of the metacognitive awareness components, the indicators of metacognitive knowledge show that each class has the highest metacognitive sub-indicators that are different. As seen in class XI MIA 1 and class XI MIA 2, the highest sub-indicator is declarative knowledge, with percentages of 72% and 71%, respectively. According to Wardana et al., students who have declarative knowledge can understand their strengths and weaknesses and then know how to overcome these weaknesses [10]. Meanwhile, class XI MIA 3 and class XI MIA 4 have the highest conditional knowledge sub-indicator, by 70%, and 76%, respectively. However, in class XI MIA 5, there are two sub-indicators of the highest metacognitive awareness with the same percentage, which is 76%. The sub-indicators are declarative knowledge and conditional knowledge sub-indicators. Students who have good conditional knowledge in learning are aware when to use a procedure, skill, or strategy, and when not to use it, and also know the reasons for using the procedure, strategy, or skill [11]. Based on the distribution graph of the metacognitive knowledge indicator, it is also clear that each

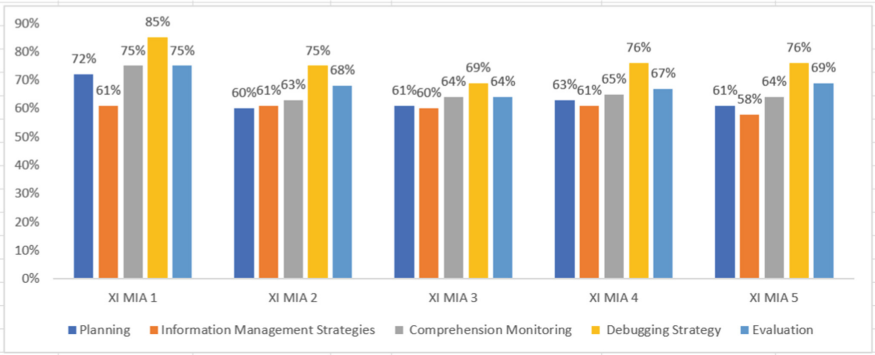

Fig. 4. Metacognitive Regulatory Indicators for Each Class XI MIA students

class has the lowest score for procedural knowledge sub-indicator. Students are said to have procedural knowledge skills if they can choose and apply appropriate procedures when they solve a problem [12].

Based on the distribution graph of the metacognitive awareness component on the metacognitive regulation indicators (Fig. 4), it is clear that each class has the same highest sub-indicator, namely the strategy debugging sub-indicator. The percentage of strategy debugging for each class from class XI MIA 1, XI MIA 2, XI MIA 3, XI MIA 4, and XI MIA 5 are 85%, 75%, 69%, 76%, and 76%, respectively. Students who have good debugging strategies will apply strategies to correct their mistakes in the learning process [13]. In contrast, the sub-indicators of metacognitive regulation are the lowest compared to other sub-indicators of metacognitive regulation as seen in classes XI MIA 1, XI MIA 3, XI MIA 4, and XI MIA 5, namely indicators of information management strategies with percentages of successively equal to 61%, 60%, 61%, and 58%. Students who have good information management strategies will focus their attention on important information or problems, so they need to make strategies to make it easier for them to understand the problem and know that the problems they face are related to something that is known [14]. However, in class XI MIA 2, the planning sub-indicator is the lowest compared to the other metacognitive regulation sub-indicators, which is 60%. It is believed that planning activities such as showing goals and task analysis help activate relevant knowledge to facilitate the organization and understanding of learning materials.

The score of the metacognitive awareness questionnaire showed that the students' metacognitive ability scores for each sub-indicator of metacognitive awareness were in the moderate to good category. This is in line with the research conducted by Fauziah et al., who found that the results of the data analysis of students' metacognitive awareness profiles in a private high school in Sragen showed that there were only three categories of metacognitive awareness levels that emerged, namely very good, good, and sufficient [15]. So, it can be said that the level of metacognitive awareness of students of class XI MIA SMA Negeri 1 Sumbawa Besar is still relatively normal.

The percentage of each sub-indicator in the metacognitive knowledge indicator and metacognitive regulation indicates that there are still several sub-indicators that have

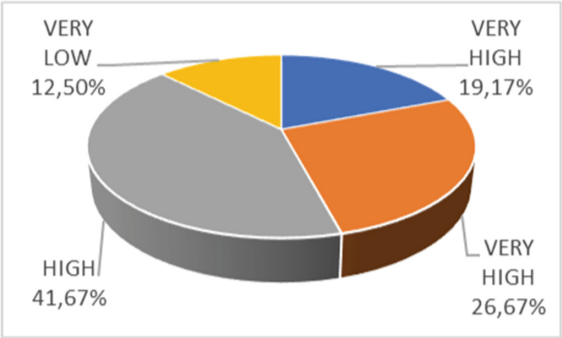

Fig. 5. Overall Data on Metacognitive Awareness of Class XI MIA Students

not been optimally implemented, such as the knowledge procedure sub-indicator and information management strategies sub-indicator. In the future, each sub-indicator of metacognitive awareness can be given special attention so that it can be improved to help the learning process achieve the goal of thinking.

3.2 Profile of Character Education Values

The values of character education for students of class XI MIA towards chemistry subjects can be seen in Fig. 5.

Based on Fig. 5, it can be concluded that the overall character education values for class XI students are mostly in the high category of 41.67%, with a total of 50 students from 120 samples. However, the values of character education for students with the low category are still quite large, with 26.67% or a total of 32 people from 120 samples. In comparison, the values of character education in the very high and very low categories have a percentage of 12.50% and 19.17%, respectively. The number of samples of class XI MIA students who are in the very high and very low categories, respectively, are 15 and 23 out of 120 samples.

The number of each category of character education values for students in class XI MIA SMA Negeri 1 Sumbawa is distributed into five classes, with the number of students in each category varying. The character education values for each class are described in Fig. 6.

The highest level of character education values in each class is different. Based on the bar graph of the class data of character education values, it can be concluded that in class XI MIA 2, XI MIA 4, and class XI MIA 5, more students have high character education values with a successive percentage of 45.83%, 58.33%, and 37.50%. While in class XI MIA 1, two categories are more than other categories, namely the high category and the low category, by 37.50%. While in class XI MIA 3, the highest category is the category of very low character education values, with a percentage of 37.50%. Based on the class distribution data, it can be concluded that the class that has applied the values of honest character education, hard work, discipline, and curiosity is better than the other classes, namely class XI MIA 4. Several factors influence the results of the study. One of the data values of character education is the grouping of SMA Negeri 1 Sumbawa

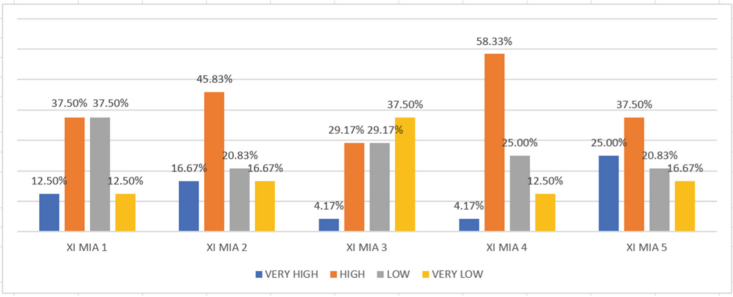

Fig. 6. Bar Graph of Class Data Character Education Values for Class XI MIA Students

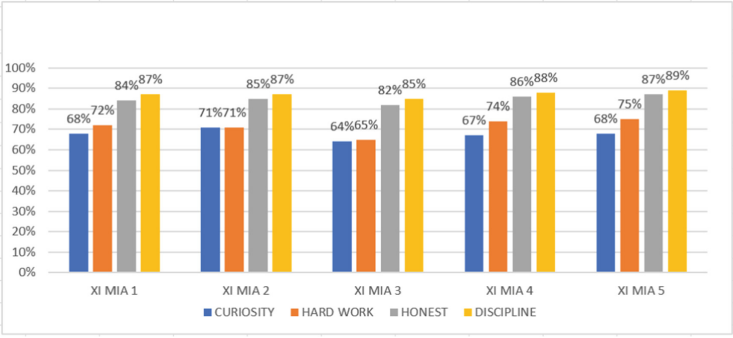

Fig. 7. Bar Graph of Metacognitive Regulations for Each Class XI MIA

Besar students based on their level of academic ability. Students who have high academic abilities are grouped in class XI MIA 4 and XI MIA 5. So, based on these data, students' academic abilities and metacognitive awareness are directly proportional to the level of character education values of honesty, hard work, discipline, and curiosity, particularly in chemistry subjects.

Based on the results of the data analysis of the questionnaire scores of character education values for each component after being interpreted, the description of the character education values of each class is shown in Fig. 7.

The purpose of analyzing each component of character education values is to be able to know the value of character education that needs to be given attention from the four characters studied (honesty, hard work, curiosity, and discipline). The data reveals that for characters in the high and very high categories, it is suggested that reinforcement should be given to retaining them. Based on the distribution graph of the components of character education values, it can be concluded that each class has the highest character value in the discipline character with a percentage above 80%. Discipline character is the most widely applied character education value by class XI MIA students due to several important factors, one of which is the discipline character education carried out by teachers in educating students to always be disciplined in learning activities in the classroom and outside the classroom. If students violate the rules, they will be subject to

strict sanctions so that students are aware and do not repeat their actions. A student who has implemented a disciplined character will always obey school rules, always follow class lessons, don't like to be truant while still in class, and don't make noise in class [16]. Likewise, the honest character possessed by students in each class is in second place after the discipline character with a percentage which is also above 80%. However, the character of students' curiosity in chemistry subjects is still a concern because it is a character value that is slightly owned by most of the sample. The student's curiosity character value is still below 70%. In line with the results of interviews conducted with class XI MIA students that their curiosity about chemistry subjects tends to decrease due to the influence of COVID-19, causing online learning to be held, making it difficult for them to understand chemistry lessons that are abstract and require reasoning at a high level. Students who have a high curiosity character will make the learning process run more productively. It is also shown that the hard-working character is still below 80%. Students who have the character of hard work tend to complete the questions or assignments given seriously [17].

The difference in the scores in the research on character education values (honesty, hard work, curiosity, and discipline) is due to the tendency of each student to have different experiences starting from birth to adulthood. Based on the results of this study, the character of SMA Negeri 1 Sumbawa Besar students that need attention is the character of curiosity and hard work in learning chemistry. These characters can be developed slowly and continuously. Character education in every high school (SMA) must pay attention that the formation of a person's character is influenced by many factors so that it can support the learning process to run well.

4 Conclusion

Based on the results of the research and discussion, it can be concluded that the metacognitive awareness of students of class XI MIA SMA Negeri 1 Sumbawa Besar towards chemistry subjects is in the high category of 36% or with a quantity of 43 students from 120 samples. The class that accumulated the highest categories in metacognitive awareness was class XI MIA 4, with a percentage of 50%.

The values of character education for students of class XI MIA SMA Negeri 1 Sumbawa Besar towards chemistry subjects are in the high category of 37% or a quantity of 50 students from 120 samples. The class that has applied the values of honest character education, hard work, discipline, and curiosity is better than the other classes is class XI MIA 4.

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